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A Comparative Study of the Skull in the Genus *Eumeces* of the Scincidæ (a Preliminary Paper).

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INTRODUCTION.

THE study of the skull of this genus presents the following problems for investigation: (1) the homology of the parts of the skull; (2) the variations in some of the bones and their position; and (3) the fusions of the bones in the various regions.

This work was done at the suggestion and under the direction of Dr. E. H. Taylor and Dr. H. H. Lane, of the Zoölogy Department of Kansas University. Charles Bunker, curator of Dyche Museum, has very kindly lent much material, most of which was collected by Doctor Taylor.

OBSERVATIONS.

A complete loss of any one bone was not observed in the study of this series of skulls, but a decided reduction was observed in the case of the postorbital bone.

In introducing the characters of the individual bones it might be well to consider the general characteristics of the skull of this genus. The characteristics are as follows:

(1) The post-temporal vacuity is present in the occipital portion of the skull between the parietal-squamosal and the paroccipital elements.

(2) The supratemporal vacuity or fontanelle is between the parietal, squamosal, postfrontal and postorbital. This is variable with the species, as some show almost none and others show it very clearly.

The following description is based on the skull of *Eumeces obsoletus*; later a comparison will be made with the various species studied.

(1) **FRONTAL.** The frontal bones are two in number located between the orbits of the eye and beneath the frontal and frontoparietal scales of the dorsal surface of the head. In the median line each is flattened except for slight depressions, while along the sides extending from the orbit to its anterior extremity there is a beveled edge that forms the support for the supraocular scales above the eyes. Anteriorly it articulates with the nasal bone, to which it unites along a crescentic suture from the median line. In the anterior lateral portion of the orbit it is in contact with the prefrontal. A small maxillary process is found on the anterior lateral surface where it comes in contact with the maxillary bone lateral to the nasal suture. Posteriorly it meets the anterior edge of the parietal bone. Laterally along the margin of the orbit it is in contact with the postorbital.

(2) **PARIETAL.** The parietal is a single median bone located beneath the parietal, interparietal and nuchal scales of the surface of the head. This is composed of a more or less triangular body which has within it, in the median line, a small opening, the parietal foramen for the organ of the same name. The opening is a little anterior to the middle of the body of the bone. Extending posteriorly are two processes, the squamosal processes. These are curved and slightly recurved away from the median line. In the median line at the posterior border there is a prominent notch into which fits a membrane and a small knob-like element that suggests the location of an "interparietal." Lateral to this notch two posteriorly directed processes extend to meet the occipital bone. Along the median and posterior border of the parietal there is a marked ridge which is continuous with an obliquely directed surface for the attachment of the neck muscles of the skull.

On the ventral surface of the body of the parietal bone and in direct line with the parietal foramen are two sliverlike processes which extend down almost at right angles to the remainder of the bone. These articulate with the epipterygoid and with the latter enforce the upper jaw and gave rigidity to the membrane surrounding the brain.

The parietal articulates with the following: frontal, squamosal, postfrontal, paraoccipital, and epipterygoid bones.

(3) **SUPRAOCCIPITAL.** The supraoccipital is an unpaired median element fused, in the adult, at the basal part of the skull with the exoccipitals, paroccipitals and some of the bones of the otic capsule. The posterior and lateral limits of this element cannot be distin-

guished in the adult. It probably forms a median raised area from the foramen magnum forward to the median line of the parietal as well as a slight flattened process on either side of raised median portion. These flattened processes contain the median portions of the semicircular canals which are visible from the dorsal surface.

(4) EXOCCIPITALS. The exoccipitals form the sides of the foramen magnum and the lateral pieces of the occipital condyle. The occipital condyle is composed of three parts; the median piece is the basioccipital while the lateral two are exoccipital parts. The main portion of this bone is inseparably fused with the paroccipitals. The lateral processes articulate with the quadrate, parietal, squamosal and supratemporal bones.

(5) BASIOCCIPITAL. The basioccipital is placed ventrad to the foramen magnum forming about thirty degrees around that aperture. The general outline of this bone is suggestive of the shape of a diamond with its long axis running from left to right. Along the anterior and lateral border of this diamond-shaped area the basioccipital articulates with the basisphenoid by an irregular suture. In the adult a slight depressed groove remains, separating the basioccipital and the exoccipital bones.

(6) BASISPHENOID. The basisphenoid is located just anterior to the basioccipital, with which it articulates by an irregular suture. The body of this bone is more or less triangular with the base posterior and its apex extending to the interorbital rostrum anteriorly; which is in the region of the presphenoid. Extending laterally from the body are two fan-shaped processes, the pterygoid processes, which form broad but thin facets for the articulation with the pterygoid as it moves with the movement of the lower jaw.

(7) PROÖTICS. The proötics are two bones between the basisphenoid, basioccipital, paraoccipital and supraoccipital bones. In the adult the sutures are not clearly visible.

(8) PARASPHENOID (presphenoid). The parasphenoid is continuous with the basisphenoid and extends forward to the prevomers and palatines. This bone has been homologized with the vomers of mammals. This element in these lizards is cartilaginous and forms the ventral support for the interorbital septum. The space in which this is located is called the interpterygoidal space. It is impossible to see where it unites with the ethmoid or sphenethmoid in prepared skulls.

(9) **QUADRATES.** The quadrates are two conspicuous bones at the posterior and lateral surfaces of the skull, articulating directly with the pterygoid on the ventroanterior surface; with the paroccipital, supratemporal and squamosal on the dorsal and posterior border. Each quadrate is concave on its ventral posterior surface, while it is convex anteriorly. There is a double articular surface for the movement of the lower jaw; the tympanic membrane and the columella are parts articulated with this bone.

(10) **PTERYGOIDS.** The pterygoid bones are long (10 mm.) and extend about half the length of the entire skull on the ventral surface. The anterior portion may be considered the body which bears teeth upon its ventral median surface. These teeth are placed in depressions and seemingly in two rows of irregular size and range from six to ten on each side. The teeth are rather heavy and are blunt at their extremity. This bone connects anteriorly with the palatines, laterally with the ectopterygoids and the jugals, while posteriorly it articulates with the quadrate, and about its middle with the basisphenoid. (The posterior process is a thin knife-bladelike process passing from the basisphenoid to the quadrate.) Its articulation with the ectopterygoid is by a broad, flat surface directly under the ectopterygoid bone. The ectopterygoid, or *os transversum*, with the pterygoid process together produce the posterior bar, the limit of the postpalatine vacuity.

(11) **ECTOPTERYGOIDS** (*os transversum* or *transpalatines*). There are two ectopterygoids, and they extend from the maxillary and jugal bones to the pterygoid, and these are the only bones with which they articulate.

(12) **EPIPTERYGOIDS.** The epipterygoids are a pair of sliver-shaped bones extending from the dorsal surface of the pterygoid to the parietal bone. The union with the pterygoid bone is made by means of a socket in which the enlarged end of the epipterygoids fit. The other end of the epipterygoid is attenuated and meets a sliver-like process extending down from the parietal bone, with which it articulates.

(13) **PALATINES.** The palatines are two in number and meet in their anterior portion. There are two plates that make up this bone, one located dorsally and one ventrally; both plates are united along the lateral margins. The ventral plate is nearly flattened and is continuous with the broad palatine process from the alveolar surface of the maxillary bone. Posteriorly it is continuous with the

anterior surface of the pterygoid. The dorsal plate has a somewhat curved surface as well as a double curved margin along the median line. At the anterior surface of this plate the left and right palatine bones come in contact. This contact is directly posterior to the prevomer teeth, which project back a little distance in the median line. The dorsal plate articulates with the prevomers anteriorly while posteriorly it unites with the pterygoids as does the other. The space between the dorsal and ventral plates of the palatine bone produces a passage for air down the sides of the prevomer to the nasal passage.

(14) PREVOMER (*vomers*, but not homologous with the vomer of mammals). The prevomers are represented in this form by a single inseparable piece in the adult, which has all evidence of being composed of two distinct parts united in a groove in the median line. At the posterior end of the plate near the median groove is found a pair of toothlike processes that may be considered the homologue of prevomerine teeth. Extending from these processes forward is a gentle ridge which becomes flattened near its articulation with the premaxillary bones. At the extreme anterior end in the median line is a tubercle with a cartilaginous tip and a slight depression on either side. Two openings may be seen along the lateral margin next to the maxillary bones; these seem to connect with a cavity in the prevomers and may be the opening to Jacobson's organ. Posterior to these openings and along the margin in the maxillary bone is a slit-like passage which is continuous with the nasal passage above.

(15) PREMAXILLARY. The premaxillary bones are two in number and are located on the anterior surface of the upper jaw. There are two distinctly separate bones in this form. Left and right elements are not equal in size as the right one is slightly larger, having four teeth while on the left side only three are present. The premaxillary bones articulate dorsally and posteriorly with the nasal bones, laterally and posteriorly with the maxillary bones and ventrally with the prevomers. The dorsal median processes form a separation between the external nares.

(16) MAXILLARIES. The maxillary bones are elongated bones that constitute the outer edge of the upper jaw and bear the majority of the teeth in this region. They form the posterior and lateral margin of the external nares and the lateral margin of the postpalatine vacuity and lateral margin at anterior edge of the orbit of the eye. The maxillary articulates with the following bones: anteriorly with

the premaxillaries, prevomers, nasals and septomaxillæ; posteriorly with the frontals, prefrontals, lachrymals, jugals, and ectopterygoids; and medially with the palatines. The outer edge of the ventral surface of the maxillary bone is raised into a flange, while the inner surface is on a lower level and is continuous with the palatine bone. The nearly cylindrical teeth are fastened to the lower surface of this bone and also to the raised flange, making the teeth pleurodont in attachment. Smaller teeth are visible on the lower surface and are the replacing teeth for worn-out older ones.

(17) JUGALS. The jugal bones are narrow bones forming the angle of the upper jaw and the outer and posterior margin of the orbit. The entire shape suggests that of a hockey stick. The straight handle-shaped portion is fastened near its end along the edge of the orbit, making up part of the lateral border. The ventral part is curved and meets the maxillary at its posterior end. Here it becomes narrowed to a very thin process that is lodged between the maxillary, ectopterygoid and lachrymal bones. On its dorsal and posterior end it articulates with the postfrontal, postorbital, and squamosal. On the ventral surface of the jaw a posterior lateral spine is seen as though it were a continuation of the upper jaw.

(18) SQUAMOSALS (*paraquadrates* of Gaupp). The squamosals as here identified articulate in front with the jugal and postorbital, at about the middle of its extent with the parietal, and posteriorly with the quadrate, supratemporal and paroccipitals. It is a flattened curved bone forming the outer border of the dorsal surface of the skull. This bone is undoubtedly not a quadratojugal, as the lateral temporal vacuity is not formed because of the disappearance of the lateral arcade.

(19) SUPRATEMPORAL (*supramastoid*, *suprasquamosal*, *tabular* of Noble, or *squamosal* of Gaupp, *epiotic*, *postparietal*). These bones are two small, insignificant, sliver-shaped bones located between the squamosal and parietal bones laterally, while posteriorly they articulate with the quadrate and paroccipital processes. They are never in contact with the postorbital and postfrontal bones in this form. In disarticulated skulls and in some prepared skulls there is an additional element that may be an atrophied tabular or quadratojugal. In most skulls it is represented as an aperture on the quadrate near its articulation with the squamosal and supratemporal at the place of its articulation.

(20) POSTFRONTALS. The postfrontal bones form the posterior border of the orbit. A thin, narrow piece extends along the margin of the frontal bone and the orbit; the body of this bone is a nearly leaf-shaped element in contact with the parietal medially and with the postorbital laterally and with the jugal on its anterolateral surface at the posterior lateral boundary of the orbit. Its posterior extremity is variable both on left and right sides on the same skull as well as in different skulls.

(21) POSTORBITALS (*postfrontals*—Gaupp). The postorbitals, two small bones in this skull, do not form part of the orbit nor part of the edge of the skull. They articulate with the postfrontal, squamosal, jugal and by a slight point touch the parietal on one side in one skull studied. Each borders on the fontanelle or vacuity on the dorsal surface of the skull. Its variation will be brought out in the comparisons of the various species to follow. Ventrally it presents a triangular appearance.

(22) PREFRONTALS (*lachrymals* of mammals—Gaupp). The prefrontal bones are located at the median anterior end of the orbit; they are inseparably united with the lachrymal bone, articulating with the frontal, maxillary and lachrymals. A part of the suture remaining suggests the place of union with the lachrymal. A marked ridge and a groove just below shows the point of attachment of the small supraocular bone, which is found in careful preparations. It is easily removed with the skin unless extra care is used.

(23) LACHRYMALS. The lachrymal bones are at the anterior extremity of the orbit and are, as previously stated, fused in the adult with the postfrontals. Each is characterized in this form by having a foramen penetrating it from the orbital side into the nasal cavity, and articulates with the maxillæ, jugals, and prefrontals.

(24) NASALS. The nasal bones form part of the septum between the external nares as well as part of the posterior boundary of the same. These bones are thin plates nearly ovoid in shape, with their anterior median extremities covered by the dorsoposterior projections of the premaxillary bones. Posteriorly they articulate with the frontals and laterally with the maxillæ. The small septomaxillæ probably do not come in contact with this element, but do with the maxillary bone.

(25) STAPES. The stapes are thin cylindrical bones that fit into the foramen ovale of the paroccipital process. They pass out posteriorly to the quadrate, where they seem to be strengthened in

their position by this bone and by the tympanic membrane on the outer surface of the head.

A COMPARATIVE STUDY OF THE EUMECES.

The following species of *Eumeces* were studied and compared with *Eumeces obsoletus* just described: *Eumeces fasciatus*,¹ *Eumeces septentrionalis*, *Eumeces tetragrammus*, *Eumeces chinensis*, *Eumeces longirostris*, *Eumeces schneiderii pavimentatus*,² *Eumeces skiltonianus*, *Eumeces humilis*, and *Eumeces laticeps*.³

In this comparative study we will discuss the separate bones of the skulls of the different species.

The frontal bone in all forms has comparatively the same shape, but there are some variations. In *Eumeces fasciatus*, *laticeps*, *longirostris*, *skiltonianus*,⁴ *schneiderii pavimentatus*, *tetragrammus* and *humilis* it touches the maxillary bone along its anterior lateral extremity. In the other three species it does not come in contact with the maxillary bone.

In *Eumeces septentrionalis* alone there was evidence of a fusion of the parietals. This may be an individual variation and may not occur regularly even in this species. The posterior median notch is very prominent in *obsoletus* and *skiltonianus* while it is decidedly insignificant in *schneiderii pavimentatus* and *chinensis*. Associated with the notch on either side are two posterior projections that fit into the occipital bones; these are long and extremely pointed in *obsoletus*, less pointed in *fasciatus*, long and blunt at the tips in *skiltonianus* and nearly lacking in *chinensis* and *schneiderii pavimentatus*. The lateral edges of the body of the parietal are more concave in those forms where the fontanelle is most striking; thus in *schneiderii pavimentatus* its outline suggests an hourglass, while in *fasciatus* the lateral boundaries are nearly parallel and no fontanelle is evident. The posterior lateral projections are broad and thick in *chinensis* and *skiltonianus* while in *tetragrammus* they are narrow and delicate. The parietal foramen is located anterior to the middle of the parietal bone in *schneiderii pavimentatus*; in *skiltonianus* and *longirostris* it is slightly posterior to the middle of the bone.

In *laticeps* a small element, here called the interparietal for want of a better name, is very prominent and fills the median posterior notch.

1. In *sensu strictu*.

2. Identified by Dr. Robert Mertens.

3. According to Dr. Edward H. Taylor.

4. This is *gilberti* of Van Denburgh, thought by Dr. E. H. Taylor to be possibly distinct from *skiltonianus*.

In the occipital region the occipital condyle is composed of two exoccipital elements and a basioccipital as was seen in both *schneiderii pavimentatus* and *chinensis*, while all the rest have lost their demarcation of elements in this region.

The paroccipital has its limits represented anteriorly by sutures on the dorsal and lateral surfaces; at the sides of the foramen magnum in *Eumeces fasciatus* and *schneiderii pavimentatus*; in all of the rest there is a ridge that marks its union with the supraoccipital. The proöties are represented at the anterior end and lateral to the supraoccipital; where in *schneiderii*, *fasciatus* and *septentrionalis* there is a remnant of a suture, the rest all show a ridge at this place of union.

The basioccipital portion of the occipital condyle is very distinct in the two forms previously mentioned; the rest of the skulls do not show a clear division, although in *Eumeces fasciatus* there is a marked groove extending from the condyle to the lateral prominences which undoubtedly represents a former line of fusion. From the lateral prominences a ridge is evident, passing about half way through the bone in all of the forms studied; it is the most pronounced in *chinensis*, where it forms a marked ridge. The rest of the bone inclines from the ridge both forward and backward. In *septentrionalis* this is but a slight elevation without any clear demarcation from the rest of the bone. The shape of the basioccipital is more nearly diamond-shaped in *chinensis* and *obsoletus* than in the rest. In these merely a suggestion of this shape, remains, as the suture uniting the basisphenoid becomes irregular or broadly united with it as in *septentrionalis*, *chinensis*, *humilis*, *skiltonianus* and *longirostris*. In *skiltonianus* the suture has become obliterated except near the midventral line, where it appears as a slightly wavy transverse line.

The basisphenoid unites directly to the basioccipital at its posterior end and the body of this bone has a broad base in *Eumeces schneiderii pavimentatus* with the lateral limits extending to the broadest part of the basioccipital; in all of the other species of the group studied except *obsoletus* the posterior limiting suture is nearly transversely directed. The fan-shaped pterygoid processes are variable. They are broadly attached to the body in *chinensis*, *schneiderii* and *obsoletus*. In all remaining skulls except *skiltonianus* the attachments are long and delicate, suggestive of the make-up of the entire skull. The alisphenoid at the side of the body helps to produce a groove extending back to the region of the quadrate. In

obsoletus, *longirostris*, *skiltonianus* and *humilis* the sutures are obliterated by fusion. Whether this is characteristic of the species or merely the age of the specimen could not be ascertained. The anterior limit of this bone extends forward into a slight projection, which is continuous with the presphenoidal rostrum; this anterior piece is quite elongated and bifurcated in *Eumeces*, while in *obsoletus* it is bifurcated but not elongated. In *longirostris* this median piece is decidedly short and has an extra, median, short lobe.

The parasphenoidal rostrum (parasphenoid) is cartilaginous in all forms and therefore not clearly comparable.

The quadrate is quite different in thickness, undoubtedly to strengthen the lower jaw. In *Eumeces chinensis* the quadrate is the heaviest bone. The lateral concavity produced by the thin bony plate extending from the mandibular condyle to its attachment to the paroccipital process produces the lateral boundary of the posterior part of the skull. The quadrate presents a conspicuous aperture in some skulls, as in *fasciatus*, *septentrionalis* and *brevilineatus*. However, in *schneiderii pavimentatus* there is in this region a small oval bone or plate that may be a dermal piece covering this aperture. This may be a remnant of former existing parts. In all other skulls studied neither this element nor the aperture was seen. Whether this was a lack of preparation or a specific character could not be ascertained.

The pterygoid in all these forms differ considerably, both in variation of the teeth and in its lateral connection. In *Eumeces longirostris* there are only two teeth on each side of the pterygoid. In *fasciatus* there is a single row of six teeth, while in *schneiderii pavimentatus* there seems to be an area of attachment of the teeth with a clearly defined row toward the outer edge of the area. In some forms the ectopterygoid process of this bone is greatly elongated, while in others it is very short. In *Schneiderii pavimentatus*, and *obsoletus*, *chinensis*, and *septentrionalis* this process extends to connect with the jugal bone at its extremity. In *fasciatus*, *longirostris* and *humilis* there is quite a long process, but it is not in contact with the jugal. In *tetragrammus* it is quite short.

The ectopterygoid is grooved in those forms with long pterygoid processes, and in that case this process fits into a groove which extends to the border of the jaw. In *chinensis*, *schneiderii pavimentatus* and *obsoletus* the ectopterygoid is considerably thicker than in *fasciatus*.

The palatines are of interest in this group because the left and

right halves are in contact along the median line. In *chinensis* the dorsal plates are in contact in the median line for about two-thirds of their way where they separate abruptly to unite with the anterior end of the pterygoid. In *schneiderii pavimentatus* the palatines resemble the condition in *chinensis* except that possibly a third of their median border is in contact, while in *obsoletus* they barely meet at the anterior part under the prevomerine teeth. The significance of the dorsal plate is not seen from a prepared skull, but in a disarticulated state it is clearly evident that this is most important, since it forms a tubelike passage for the air from the side of the prevomers to the mouth cavity. This passes by way of the internal nares which open beside the palatines rather than in the region of the prevomers. The most noticeable variation of this bone is in the inner margin of the ventral plate. In *longirostris* its margin is a regular S-shaped curve extending from its anterior to its posterior limit. In *humilis* it is very similar, but its contact is much more abrupt. In *fasciatus* there is a pronounced point or shoulder on the anterior median edge of the ventral plate. This is unique among the species studied, although there is an approximation to this condition in *chinensis*. A foramen is visible on some skulls from the ventral surfaces, passing from the orbit into the nasal cavity. In *chinensis*, *fasciatus*, *humilis*, *skiltonianus*, and *septentrionalis* it may be seen from the ventral surface, while in the rest it may be too small and at such an angle that it is not evident from either surface.

The prevomers bear toothlike posterior projections in all forms studied, but these are not constant in the number present. In *Eumeces schneiderii pavimentatus* two posteriorly directed projections are present on either side, making four altogether in this region, while all of the rest have only two. In *septentrionalis* the bone is almost as wide as it is long, while in *schneiderii pavimentatus*, *obsoletus*, *skiltonianus* and *longirostris* it is about twice as long as it is broad, as seen from the ventral surface. The apertures that seem to be the internal nares or choanæ are very evident from the ventral surface, but are probably openings to Jacobson's organ. Just posterior to these apertures on *skiltonianus* and *longirostris* is a pronounced depression that passes from the median line to the edge of the mandible. This marks the posterior limit of Jacobson's organ in the internal capsule within this bone.

The premaxillaries are two in number and are usually unequal in size and usually bear an unequal number of teeth. In only *Eumeces chinensis* are the teeth of the same number on both sides,

three in each bone. Even here the two bones cannot be said to be equal in size on both sides. In *longirostris* there are two teeth on the left side and three on the right side, all the rest of the species studied had three on the left side and four on the right side. To make room for the difference in teeth on the two sides the suture dividing left and right is merely turned farther over on the left side than on the right.

The maxillary bones do not differ greatly in the various species. The maxillary bones are in contact with the frontal bones in all forms studied except *Eumeces chinensis* and *septentrionalis*, where the prefrontals and nasals intervene. In the skull of *Eumeces humilis* studied, the maxillary bone is in contact on one side and not on the other side. The teeth are variable in the various species, averaging about twenty-two teeth to each side.

The jugals have a wide variation, particularly at the posterior angle of the jaw or at the broadest part of the head near the orbits of the eyes. There is in three species—*obsoletus*, *schneiderii pavementatus* and *skiltonianus*—a posterolateral point on the jugal that suggests the place of continuance of some element in the past. In its posterior limit we see that the jugal connects with the squamosal in *tetragrammus*, while in *obsoletus*, *humilis* and *septentrionalis* they are barely in contact. In *schneiderii*, *fasciatus* and *skiltonianus* the edge of the jugal is separated from the squamosal by the slight intervening gap of the postorbital. In *longirostris* and *chinensis* the jugal does not articulate with the squamosal, as the postorbital lies between them.

The prefrontals are in contact with the nasals in some forms, while in the rest the frontal intervenes and is in contact and possibly fused with the lachrymal bones. It is to the lateral anterior border that the supraoculars are attached, as can be seen in carefully prepared skulls.

The lachrymals are inseparably fused with the prefrontals, though probably separate in younger forms. In most of the skulls studied the lachrymal is in contact with the jugals.

The nasals articulate with premaxillaries, maxillaries and frontals in *Eumeces obsoletus*, but are also in contact with the prefrontals in *chinensis*, *fasciatus*, *laticeps*, *septentrionalis* and *humilis*.

The postfrontal bones are modified with the appearance of a vacuity or fontanelle on the dorsal surface of the skull. In skulls without a fontanelle this bone is greatly elongated posteriorly, while in skulls with a fontanelle this bone is either shortened posteriorly

or narrowed laterally. Although the skull of *skiltonianus* has a fontanelle or vacuity this bone is similar to other solid-skulled forms. In this specimen the postorbital seems to be shortened or lacking. In *chinensis*, *septentrionalis* and *tetragrammus* the skulls are solid with no sign of opening or fontanelle, while in *laticeps* there is a suggestion of an opening on one side, as if it were a remnant of a fontanelle. In *skiltonianus* this bone is broad and long and shows no sign of shortening, but a fontanelle is present as if formed by the partial disappearance of the postorbital at the posterior end. In *obsoletus* the two sides are variable, and on one side it is greatly shortened while on the other side it is an irregular sliver between the squamosal and the parietal; a fontanelle is present, however, on both sides. This form seems to be a transitional stage as the two sides are irregular, but how much of an individual variation may be seen in this is hard to say. In *fasciatus* there is a fontanelle, and in comparison with *skiltonianus* it is shortened, leaving a slight space of irregular shape between parietal, postorbital and postfrontal bones as if this bone had shortened, leaving merely a membrane in its place. In *longirostris* the median posterior border seems to be eroded, leaving a space or vacuity of greater extent than the two former species. In *Eumeces humilis* great shortening has been accomplished, but here, instead of a concave outline posteriorly, the limit is decidedly convex, the cavity is slight between the parietal and postorbital; more extensive than in *fasciatus* but less than in *Eumeces longirostris*. In *Eumeces schneiderii pavimentatus* the vacuity is the greatest of all forms studied, and the posterior extent of this bone is shortened, leaving a concave outline; accompanying this shortening, the parietal bone has become indented, allowing more space along its lateral border. This is the climax of retrogression in all forms studied.

The postorbitals are associated with the fontanelles and seem to show a dwindling in the series studied. This bone is connected directly in some skulls with the appearance of the fontanelle while in others the fontanelle is absent but the bone has dwindled. In *Eumeces chinensis* and *tetragrammus* the skull is solid and the bone is elongated, probably extending to its limit posteriorly. In *chinensis* this bone is located along the lateral border of the skull, as the jugal and squamosals are separated. Next is a series of skulls that seem to represent a degeneration or progressive shortening and dwindling of the bone when the fontanelle appears. The series is as follows: *Eumeces skiltonianus*, *fasciatus*, *humilis*, *longirostris*, *schneiderii*

pavimentatus. Two other species may be added as a continuance of this dwindling but without having a fontanelle. What may have become of it or whether these have ever had them is hard to determine as no evidence exists. In *laticeps* and *septentrionalis* this bone has continued dwindling. In the last-mentioned one it is only a small sliver between the postfrontal and jugal and squamosal bones.

The squamosal, because of its marginal connection with the posterior limits of the skull and its association with jugal and parietal, is of interest, but is not so variable as some of the other bones. In *tetragrammus* the anterior connection of the squamosal with the jugal is broad and firm and is about equal to the postorbital and postfrontal in size. In the following four species, *fasciatus*, *obsoletus*, *septentrionalis*, *humilis*, the squamosal connects with the jugal by a slight articulation. In *skiltonianus* and *laticeps* there is a slight separation and the postorbital intervenes between jugal and squamosal. In *longirostris* and *chinensis* there is a gap between the jugal and squamosal.

The supratemporal is a curved sliver-shaped bone located between squamosal, parietal, paroccipital and quadrate bones. In *chinensis* it seems as a mere sliver slightly separated from the postorbital bone, while in *fasciatus* on the right side it is definitely in contact with it. In *Eumeces septentrionalis* it is slim and continued anteriorly, but not in contact with the postorbital. In *laticeps* it is widely separated from the postorbital.

CONCLUSIONS.

The following conclusions may be drawn from the foregoing observations on the skulls of *Eumeces* of the *Scincidae*.

Changes are taking place in the dorsal surface of the skull, *e. g.*:

(1) A vacuity or fontanelle appears between the parietal, squamosal and postfrontal bones.

(2) The postorbital is either greatly elongated and broad; or short and triangular; or sliver-shaped, elongated and narrowly pointed at each end.

(3) The jugal has probably been lost completely.

(4) The supratemporal is small and crowded between the squamosal and parietal bones.

(5) The squamosal forms the posterior lateral angle of the skull extending from the quadrate to the jugal.

(6) The interparietal region has a small bone that has been called

the interparietal for want of a better term. This may be the dermal supraoccipital, which is not recognized as occurring in the squamata.

(7) The supraocular lies along the anterior median surface of the orbit.

(8) The premaxillary teeth are three in number on the left side and four on the right (one exception 3-3, *vide supra*); the two bones are unequal in size.

(9) The pterygoid teeth and the maxillary teeth are quite variable.

(10) A small bony plate on the quadrate bone may be the remains of the quadrate-jugal.

(11) Small posterior toothlike processes are invariably present, suggestive of vomerine teeth.

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EXPLANATION OF ABBREVIATIONS.

BAO.....	Basioccipital.	PARO.....	Paroccipital.
BSP.....	Basisphenoid.	PFR.....	Postfrontal.
COL.....	Columella.	PO.....	Postorbital.
EPG.....	Epipterygoid.	P. PA. V.....	Postpalatine vacuity.
EXO.....	Exoccipital.	PREMAX.....	Premaxillary.
FR.....	Frontal.	PRF.....	Prefrontal.
FV.....	Fontanelle-vacuity.	PREVOM.....	Prevomer.
INTP.....	Interparietal.	PRO.....	Proötic.
JU.....	Jugal.	PTG.....	Pterygoid.
LA.....	Lachrymal.	Q.....	Quadrate.
MAX.....	Maxillary.	SO.....	Supraoccipital.
NA.....	Nasal.	SQ.....	Squamosal.
PA.....	Parietal.	SUA.....	Supraocular.
PAL.....	Palatine.	SUPT.....	Supratemporal.

EXPLANATION OF PLATES.

Note.—All specimens originally drawn $\times 10$ and reduced.

PLATE XXI.

FIG. 1. *Eumeces chinensis* (Gray) Amoy, China. Adult male. E. H. Taylor, Private Coll. No. 880. S. F. Light. Coll. Skull dorsal view. (Quadrate disarticulated but reconstructed in place.)

FIG. 2. *Eumeces chinensis* (Gray) same specimen, ventral view.

FIG. 3. *Eumeces obsoletus* (Baird and Girard). E. H. Taylor Coll. No. 881, Lawrence, Kan. E. H. Taylor, Coll. Skull, dorsal view.

FIG. 4. *Eumeces obsoletus* (Baird and Girard). Same specimen, ventral view.

PLATE XXI.

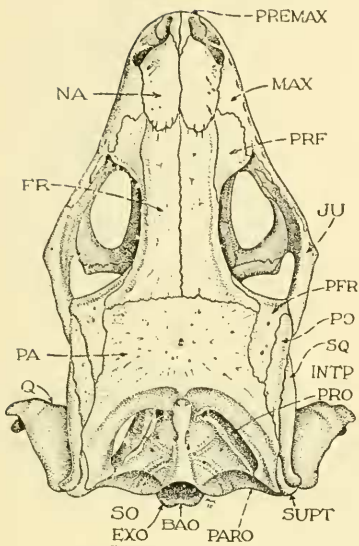
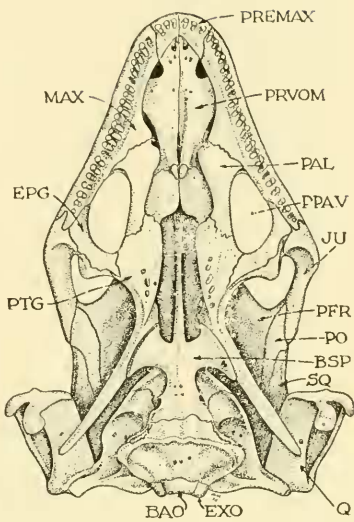
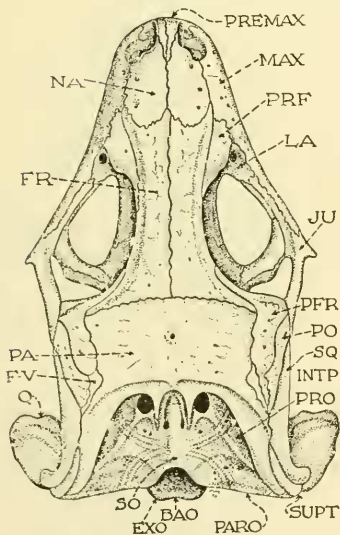
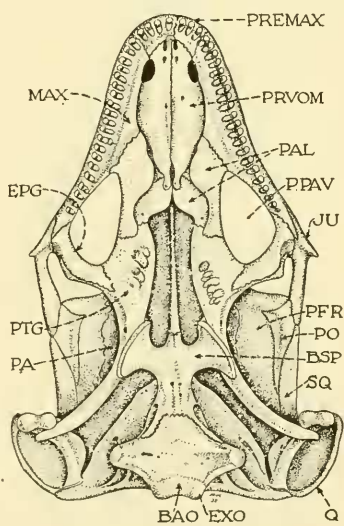
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PLATE XXII.

FIG. 1. *Eumeces laticeps* (Schneider). Kansas University Museum, No. 9127, Imboden, Ark. Byron Marshall, Coll. Adult female [here considered distinct from *fasciatus*]. Skull, dorsal view.

FIG. 2. *Eumeces laticeps* (Schneider). Same specimen, ventral view.

FIG. 3. *Eumeces schneiderii pavimentatus* (Geoffroy). Haiffa, Syria. No. S60, E. H. Taylor Coll. (Identified by Dr. R. Mertens.) Skull, dorsal view.

FIG. 4. *Eumeces schneiderii pavimentatus* (Geoffroy). Same specimen, ventral view.

PLATE XXII.

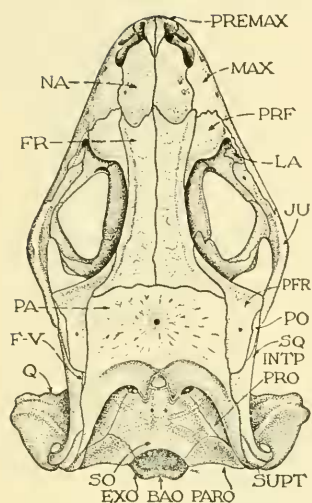
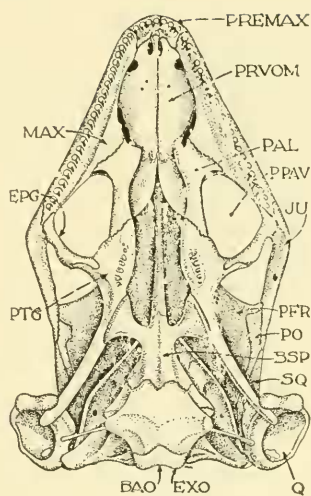
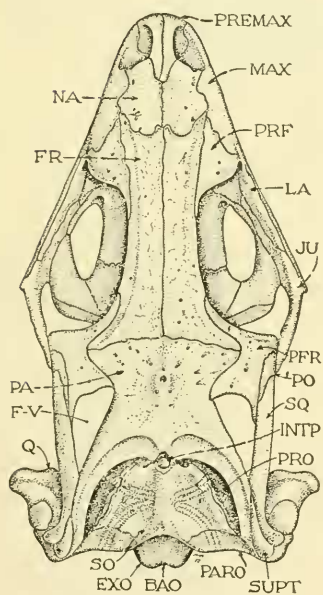
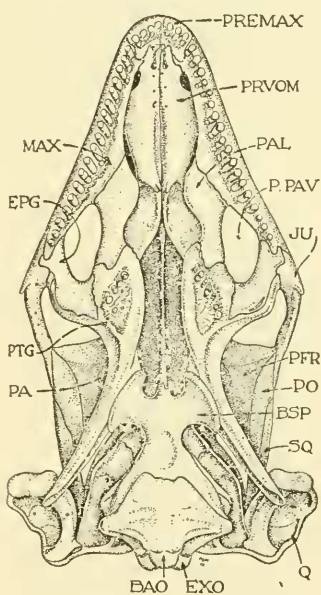
1. *Eumeces laticeps*2. *Eumeces laticeps*.3. *E. schneiderii pavimentatus*.4. *E. schneiderii pavimentatus*.

PLATE XXIII.

FIG. 1. *Eumeces humilis* Boulenger? K. U. M. No. 7301, E. H. Taylor, Coll. (Not certainly identified). Skull, dorsal view.

FIG. 2. *Eumeces humilis* Boulenger. Same specimen, ventral view.

FIG. 3. *Eumeces tetragrammus* (Baird). E. H. Taylor, Private Coll., No. 804, Cameron county, Texas. E. H. Taylor, Coll. Skull, dorsal view. (Partly reconstructed, teeth figured but part missing.)

FIG. 4. *Eumeces tetragrammus* Baird. Same specimen, ventral view.

FIG. 5. *Eumeces septentrionalis* (Baird). K. U. M. No. 7361, Douglas county, Kansas. J. R. Jeffries, Coll. Skull, dorsal view.

FIG. 6. *Eumeces septentrionalis* (Baird). Same specimen, ventral view.

PLATE XXIII.

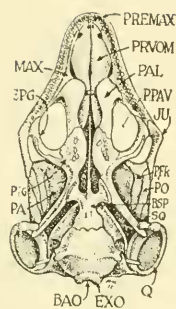
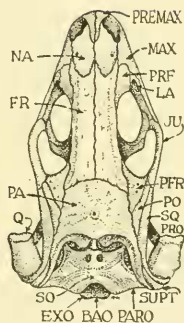
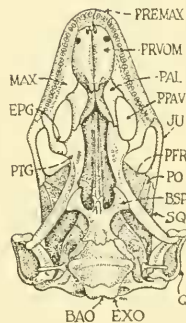
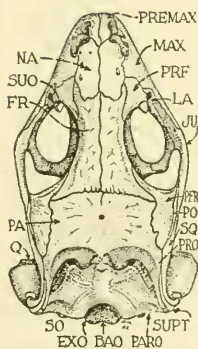
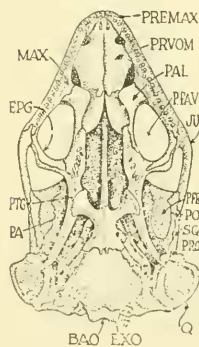
1 *Eumeces humilis*2 *Eumeces humilis*3 *Eumeces tetragrammus*.4 *Eumeces tetragrammus*.5 *Eumeces septentrionalis*6 *Eumeces septentrionalis*

PLATE XXIV.

FIG. 1. *Eumeces skiltonianus* (Baird and Girard). (*Eumeces gilberti* Van Denburgh.) K. U. M. No. 8796, San Diego county, California. L. M. Klauber, Coll. Skull, dorsal view.

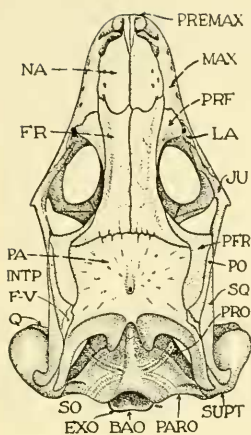
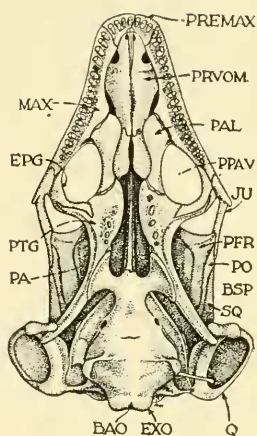
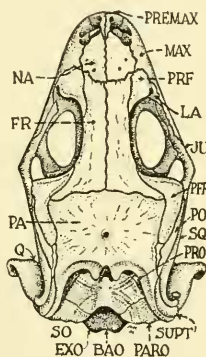
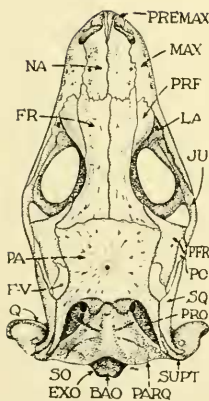
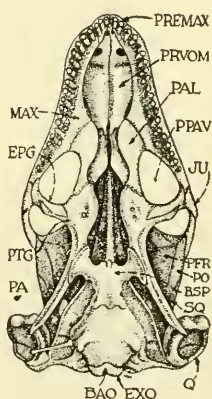
FIG. 2. *Eumeces skiltonianus* (Baird and Girard). Same specimen, ventral view.

FIG. 3. *Eumeces fasciatus* (Linnaeus). Douglas county, Kansas. R. H. Beamer, Coll. Skull, dorsal view.

FIG. 4. *Eumeces longirostris* Cope. K. U. M. No. 8211. Bermuda, Castle Island. T. H. Bean, Coll. Skull, dorsal view.

FIG. 5. *Eumeces longirostris* Cope. Same specimen, ventral view.

PLATE XXIV.

1 *Eumeces skiltonianus*2. *Eumeces skiltonianus*.3. *Eumeces fasciatus*4 *Eumeces longirostris*.5. *Eumeces longirostris*.